

REMARKS

Claims 1-30 are currently pending in the subject application, and are presently under consideration. Claims 1-30 stand rejected. Claims 12 and 18 have been amended. Favorable reconsideration of the application is requested in view of the amendments and comments herein.

I. Rejection of Claims 18 and 26 under 35 U.S.C. 112

The Office Action rejects claims 18 and 26 under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement.

Claim 18 has been amended to correct some typographical errors. Applicant respectfully disagrees with the contention, as the subject matter recited in claim 18 is adequately disclosed in the specification. For example, the present application, at paragraph [0060], states that “[t]he processor 102 can retire the MAF entry associated with the write-back request in response to receiving corresponding acknowledgement responses from the other processors 104 and 106 in the system 100.” Applicant submits that the above description adequately supports the subject matter recited in claim 26 to satisfy 35 U.S.C. 112, first paragraph. Additionally, at paragraph [0064], in describing the example depicted in FIG. 4, the present application states that “[a]fter receiving responses to the XVICTIM message from all other nodes 164-166 in the network 160, the node 162 can retire the MAF entry 170.”

In view of these and other examples disclosed in the present application, applicant submits that one of ordinary skill in the art would be enabled to make, use and practice the subject matter recited in each of claims 18 and 26. Accordingly, Applicant respectfully requests that this rejection be withdrawn.

II. Rejection of Claims 1-5, 7-10, 12-27, and 29-30 under 35 U.S.C. 103

Claims 1-5; 7-10, 12-27 and 29-30 stand rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent Publication No. 2004/0002992 to Cypher et al. (“Cypher”) in view of U.S. Patent Publication No. 2003/0217236 to Rowlands (“Rowlands”). Withdrawal of this rejection is respectfully requested for at least the following reasons.

In regard to claim 1, the Office Action contends that Cypher discloses a system having a first node that includes an ordering point for data and that the first node broadcasts a message to at least one other node in the system in response to an acknowledgement provided

by the memory indicating that the ordering point of the data has migrated from the first node to the memory. Applicant respectfully disagrees with this contention. First, Cypher fails to teach or suggest a write back transaction associated with writing data back to memory and that am ordering points could migrate from a node to the memory, as recited in claim 1. Cypher also fails to teach or suggest that a first node would broadcast a message to one or more other nodes in the system in response to an acknowledgement provided by the memory indicating that the ordering point has migrated from such first node to the memory. Instead, Cypher discloses that various ordering points are established within the node; namely, the Broadcast Network can be an ordering point and that a client may serve as an ordering point. See Cypher at paragraphs [0075] and [0076]. However, nothing in Cypher suggests memory would provide an acknowledgement indicating that the ordering point for the data has migrated from the first node to the memory, as recited in claim 1. In the absence of Cypher teaching the use of such an acknowledgement, there likewise exists no suggestion or motivation in Cypher to have a node broadcasting a write-back message in response to the acknowledgement that is provided by the memory.

Additionally, the disclosure in Cypher that the system can operate in a broadcast (or BC) mode further does not provide a suggestion that any broadcast message would be provided in response to the acknowledgement as recited in claim 1. Instead, Cypher's BC mode refers to use of a protocol in which requests are broadcast to all processors and memory through a totally ordered network. See, e.g., Cypher at paragraph [0007]. As discussed above, however, Cypher fails to teach or suggest that an ordering point can migrate from a node to memory, such that there is no basis to conclude from Cypher (as well as from the combination of Cypher and Rowlands) that a first node would broadcast a message to at least one other node in the system in response to the acknowledgement provided by the memory, which, as recited in claim 1, indicates that the ordering point has migrated from the first node to the memory.

The deficiencies of Cypher are not cured by the addition of Rowlands. For instance, the mention of using either the Kill_Ack or write back (WB) commands at paragraph [0065] of Rowlands fails to include a teaching or suggestion that memory provides an acknowledgement that indicates that the ordering point has migrated to the memory. Rowlands further fails to teach or suggest that any message is broadcast by the first node (which included the ordering point for the data) in response to the acknowledgement provided by the memory. Instead, Rowland teaches that the WB command is a command

that is used to write back a cache block (see Rowlands at paragraph [0065]), although Rowland fails to teach or suggest that any use of such WB command would include broadcasting a write-back message, as recited in claim 1. Therefore, even if the write back command of Rowlands were utilized in the system of Cypher, as suggested in the Office Action at page 4, the resulting system would not provide the subject matter recited in claim 1.

Additionally, the Office Action suggests that use of a write back command by a node to write back a remote cache block that is being evicted from the node corresponds to an ordering point migration. However, Rowlands teaches that the write back command is provided in response to a Flush command, and that the “Flush command is used to request that a remote modified owner of a cache block return the cache block to the home node (and invalidate the cache block in the remote modified owner).” Rowland at paragraph [0064]. Rowland further discloses that the Flush command is issued by the memory bridge 32 at the home node of the cache block. Rowland at paragraph [0064]. This is in contrast to claim 1, which recites that the first node (that includes the ordering point) employs a write back transaction associated with writing the data back to memory and that the first node broadcasts a write-back message to at least one other node in the system in response to the acknowledgement provided by the memory. Therefore, Rowlands and Cypher (individually or in combination) fail to teach or suggest a system that includes structural and functional interrelationships between the first node and memory as recited in claim 1.

For these reasons, Applicant respectfully requests reconsideration and allowance of claim 1 as well as claims 2-8 that depend from claim 1.

Regarding claim 2, Rowlands fails to teach or suggest the first node comprises a processor having an associated cache that comprises plurality of cache lines, in which one of the cache lines has a cache state that defines the cache line as a cache ordering point for the data prior to the first node employing the write-back transaction. Instead, Rowlands states “there are two ordering points in the system for a given operation to a remote cache block: the interconnect 22 in a remote node and the interconnect 22 in the home node.” See Rowlands at [0112] and FIG. 9. The interconnects 22 couple processors 12A-12N, the memory controller 14 and the L2 cache 36 and operates as a transaction bus for processing various transactions, such as shown in FIG. 3. See Rowlands at [0032] to [0034], [0048] and [0061] to [0063]. Such ordering points are further described as being used to maintain intranode coherency and internode coherency by employing an address phase, a response phase and a data phase. Rowlands at [0048] and [0109]. Additionally, Rowland further

teaches that a remote line directory 34 in the home node is used to track state of local cache blocks in remote nodes. See Rowlands at [0036]. However, Rowlands fails to teach or suggest that the first node (from claim 1) comprises a processor having an associated cache that comprises plurality of cache lines in which one of the cache lines has an associated state that defines the cache line as a cache ordering point for the data prior to employing the write back transaction. Since Cypher and Rowlands, whether taken individually or in combination, do not teach or suggest dependent claim 2, claim 2 is not obvious. Applicant respectfully requests reconsideration and allowance of claim 2.

In contrast to the contention in the Office Action, Rowlands contains no teaching or suggestion that one or more other nodes in the system provide a response to the first node to acknowledge the write-back message broadcast by the first node, as recited in claim 3. For example, paragraph [0065] of Rowlands simply discloses the use of a WB command, but fails to teach the broadcasting of a write-back message as well as any responses that might be provided in response to such write-back message, as recited in claim 3. Accordingly, reconsideration and allowance of claim 3 are respectfully requested.

The Office Action contends that Rowlands teaches the subject matter recited in claim 4, which depends from claim 3. In addition to the reasons described above for claims 1 and 3, Rowlands and Cypher (whether taken individually or in combination) fail to teach or suggest that the first node maintains the write-back transaction (recited in claim 1) active until the first node receives responses from at least one other node to the write back message broadcast by the first node. The Office Action appears to suggest that use of a retry by one of the interconnects 22, a taught by Rowlands, correspond to a node that keeps a write-back transaction active. However, paragraph [0113] of Rowlands discloses that an interconnect may support retry, but that address transfer is cancelled and treated as if it hasn't occurred yet. In sharp contrast, claim 4 recites that the write-back transaction remains active until the node employing the transaction receives responses to the write-back message that was broadcast by such node. Accordingly, Applicant respectfully requests reconsideration and allowance of claim 4.

Regarding claim 5, The Office Action contends that Rowlands discloses a third node that issues a source broadcast request for the data employing a source broadcast protocol, the third node retrying the source broadcast request for the data in response to recognizing a conflict associated with the source broadcast request for the data. Applicant respectfully disagrees. Rowlands fails to teach or suggest the use of a source broadcast protocol. While

Rowlands discloses that more than one node may exist in its system, it fails to disclose that a third node retries a source broadcast request for the data in response to recognizing a conflict associated with the source broadcast request. Significantly, Rowlands also fails to teach or suggest the capability of recognizing a conflict, much less the particular subject matter recited in claim 5 in response to recognizing a conflict. Applicant submits that the scenario recited in claim 5 does not exist in the system taught by Rowlands or in the combination of Cypher and Rowlands. The reliance on the retry capability of the interconnects (Rowlands at paragraph [0113]) fails to provide any suggestion or motivation to retry a request for data (especially not a source broadcast request), as recited in claim 5. For at least these reasons, Applicant respectfully requests that the rejection of claim 5 be withdrawn.

Claim 7 depends from claim 5 and is patentable over the combination of Cypher and Rowlands for at least the same reasons that claim 5 is allowable. Additionally, regarding claim 7, Rowlands fails to teach or suggest that a third node retries the source broadcast request (in response to recognizing a conflict, as recited in claim 5) by employing a forward progress protocol. Instead, it appears that the retry utilized or initiated by the interconnect 22, which is not a node (see Rowlands at paragraphs [0032] through [0035]), would employ the same protocol through which the transaction was initiated. See Rowlands at [0113]. Moreover, Cypher fails to teach that a node would retry of a source broadcast request employing a forward progress protocol in response to recognizing a conflict, as recited in claims 5 and 7. For example, Cypher determines the mode and protocol according to the request that is issued, not in response to detecting a conflict for a source broadcast request issued by employing a source broadcast protocol. See the Abstract of Cypher and at paragraphs [0011] to [0013] and paragraphs [0036] to [0040] under the heading Hybrid Network Switch. Accordingly, Cypher et al. teaches that the type of protocol implemented is dependent upon information in a mode table based upon the request transaction received. Cypher et al. at [0038]. For at least these reasons, Applicant respectfully requests reconsideration and allowance of claim 7.

Regarding claim 8, the Office Action contends that Rowlands discloses claim 8 based on the information contained in paragraph [0065]. As discussed above with respect to claim 1 (from which claim 8 depends), Rowlands simply discloses that at write back (WB) command can be issued, either in response to a Flush command or to write back a remote cache block that is being evicted, to return the cache block to the home node. Rowlands at [0065]. Rowlands fails to teach or suggest that the first node also broadcasts write-back to at

least one other node in response to an acknowledgement provided by the memory, as recited in claim 1. Moreover, claim 8 further recites that the first node includes a request engine that allocates an entry in a miss address file associated with the write-back transaction for the data and that the entry in the miss address file is maintained until responses have been received from all other nodes in the system to the write-back message. In contrast to the unsupported contention in the Office Action, Rowlands fails to teach or suggest that an entry in a miss address file associated with a write-back transaction might be maintained until responses to a broadcast write-back message have been received from other nodes in the system. In particular, since Rowlands fails to teach or suggest that a write-back message is broadcast, how or why would there by any teaching of maintaining an entry in a miss address file until responses have been received from other nodes to such write-back message that was broadcast? Cypher is similarly deficient regarding the subject matter in claim 8 such that the combination of Cypher and Rowlands also fails to teach or suggest claim 8. Applicant respectfully requests reconsideration and allowance of claim 8.

The Office Action rejects claim 9 relying the same rational it applied to claims 1 and 2. Similar to as discussed above with respect to claims 1 and 2, neither Cypher nor Rowlands teaches or suggests that an ordering point is transferred from a cache of a processor to memory as part of a write-back request. Consequently, as also discussed above, Cypher and Rowlands fail teach or suggest that the first processor provides a source broadcast write-back request to the system in response to an acknowledgement provided by the memory. Moreover, similar to as discussed above with respect to claim 3, the combination of Cypher and Rowlands also fails to teach that one or more other processor provides an acknowledgment response to the first processor in response to the source broadcast write-back. Therefore, for reasons similar to those discussed herein with respect to claims 1-3, claim 9 would not have been made obvious by Cypher et al. in view of Rowlands. Applicant respectfully requests reconsideration and allowance of claim 9.

For similar reasons to those discussed above with respect to claim 5, claim 10 is patentable over the combination of Cypher et al. in view of Rowlands. For example, Rowlands and Cypher, whether taken individually or in combination, fail to teach or suggest a system that employs a source broadcast protocol in conjunction with transferring an ordering point from an associated cache to memory, as recited in claim 10. Applicant respectfully requests reconsideration and allowance of claim 10.

Claim 12 has been amended to depend from claim 10 to correct an inadvertent typographical error. Claim 12 is patentable over Cypher et al. in view of Rowlands for at least similar to those discussed above with respect to claims 10 and 7. Therefore, Applicant respectfully requests reconsideration and allowance of claim 12.

Claim 13 depends from claim 9 and is allowable for at least the reasons stated above with respect to claim 9. Additionally, Rowlands fails to disclose or suggest a miss address file associated with a write-back transaction for the data that is maintained in the miss address file until responses have been received from all other nodes in the system to the write-back message broadcast by the first node, as recited in claim 13. Claim 13, therefore, is also patentable over combination of Cypher et al. in view of Rowlands for reasons similar to those further stated above with respect to claim 8. Applicant respectfully requests reconsideration and allowance of claim 13.

Regarding claim 14, Rowlands fails to disclose that any cache line contains the desired data in a state that defines the cache line as an ordering point for the desired data prior to issuing the write-back request to the memory. Instead, as discussed above, Rowlands states there are two ordering points in the system for a given operation to a remote cache block: the interconnect 22 in a remote node and the interconnect 22 in the home node which are not cache lines. See Rowlands at [0112] and FIG. 9. Additionally, it appears that the memory bridge 32 cooperates with the interconnects 22 to receive and process commands. Rowlands at paragraph [0040]. However, similar to as discussed above with respect to claim 9, neither Cypher et al. or Rowlands teaches or suggests the transfer of ordering points from cache of a processor to memory, as recited in claim 9, nor does Cypher or Rowlands teach or suggest that a state of data can define the cache line as the ordering point for data, as recited in claim 14. Instead, Rowlands teaches an approach where a home node tracks the state of data to provide for both intranode and internode coherency. See Rowlands at [0038]. Claim 14 is not obvious in light the combination of Cypher et al. in view of Rowlands. Applicant respectfully requests reconsideration and allowance of claim 14.

The Office Action contends that Rowlands discloses claim 15. In contrast to this contention, and for similar reasons to those stated above with respect to claims 1-3, Rowlands fails to teach or suggest the subject matter recited in claim 15. For example, Rowlands does not disclose that a state defines the cache line as the ordering point for the desired data, which ordering point is transferred from the cache line to memory. Instead, Rowlands states that the interconnects 22 are ordering points in the system for a given operation to a remote cache

block. See Rowlands at [0112] and FIG. 9. For these reasons and those stated above with respect to claims 1-3, Applicant respectfully requests reconsideration and allowance of claim 15.

Similarly to as discussed above for claim 1, neither Cypher nor Rowlands, taken individually or in combination, teaches or suggests that a source broadcast write-back message is provided in response to memory acknowledging receipt of a write-back request, as recited in claim 16. For example, while Rowlands teaches the use of a write back command (see Rowlands at paragraphs [0088] and [0090]), Rowlands fails to teach or suggest any means for providing the source broadcast write-back message as recited in claim 16. Accordingly, reconsideration and allowance of claim 16 are respectfully requested.

The Office Action contends that claim 17 is obvious over the combination of Cypher and Rowlands based on the same rational applied to claim 2. However, the rationale applied to claim 2 appears irrelevant to the subject matter recited in claim 17, which recites means for acknowledging receipt of the source broadcast write-back message. Claim 17, thus, is patentable because the Office has failed to meets its initial burden in presenting a *prima facie* case of unpatentability. Moreover, similarly to as discussed above with respect to claim 3, neither Rowlands nor Cypher teaches or suggests that a source broadcast write-back message is issued, as recited in claim 16, such that there is no basis to provide means for acknowledge receipt of such source broadcast write-back message, as recited in claim 17. This proposition is fully supported by deficiency that exists in the combined teachings of Cypher and Rowlands. For these reasons, Applicant respectfully requests reconsideration and allowance of claim 17.

Claim 18 has been amended to depend from claim 17 to correct an inadvertent typographical error. The Office Action relies on the same rationale applied to claim 5 to support its rejection of claim 18. However, the reliance on the rationale in the rejection of claim 5 does not support that claim 18 is unpatentable over Cypher et al. in view of Rowlands. Claim 18, thus, is patentable because the Office has failed to meets its initial burden in presenting a *prima facie* case of unpatentability. Additionally, similar to the reasons discussed above with respect to claims 4 and 8, Rowlands and Cypher fail to include any teaching or suggestion of any structure that might retire an outstanding transaction associated with migration of the ordering point to the memory from the associated cache in response to receiving the acknowledgement of source broadcasts write-back message, as recited in claim 18. The brief mention in Rowlands of a write back command does not

amount to a teaching or suggestion of the acknowledgement and use of source broadcast write-back message and other structural and functional features recited in claim 18. Accordingly, reconsideration and allowance of claim 18 are respectfully requested.

Claim 19 depends from claim 16 and is patentable over Cypher et al. in view of Rowlands for reasons similar to those discussed above with respect to claim 16. As discussed above with respect to claim 5, the Office Action has not identified any teaching in Rowlands that might correspond to the means for recognizing a conflict associated with the data, as recited in claim 19. Applicant submits that such failure is due to the absence of any such teaching in Rowlands. Therefore, Applicant respectfully requests reconsideration and allowance of claim 19.

Claim 20 depends from claim 16 and is patentable for at least the reasons stated above with respect to claim 16. Claim 20 further is patentable over the combination of Cypher and Rowlands for reasons similar to those discussed above with respect to claim 2.

Claim 21 depends from claim 20 and is patentable for at least the reasons stated above with respect to claim 16. Claim 20 further is patentable over the combination of Cypher and Rowlands for reasons similar to those discussed above with respect to claim 15.

Claim 22 depends from claim 16 and is patentable for at least the reasons stated above with respect to claim 16. Claim 20 further is patentable over the combination of Cypher and Rowlands for reasons similar to those discussed above with respect to claim 15 in relation to transitioning the cache to an invalid state.

Regarding claim 23, the Office Action relies on the rationale used to reject claim 1. This rationale is deficient as applied to claim 23 for reasons similar to those discussed above with respect to claim 1. For example, neither Cypher nor Rowlands, taken individually or in combination, teaches or suggests that a source broadcast message from the first processor node is issued to other nodes in response to acknowledging receipt of the write-back request at the memory. The Office Action admits a deficiency in Cypher regarding any teaching of a write back request. As discussed above, the teaching of a write back command in Rowlands stills falls short of any teaching or suggestion that receipt of a write back request is acknowledged at the memory or of any teaching or suggestion that a source broadcast message is issued to other nodes, as recited in claim 23. Accordingly, for these reasons and those stated above with respect to claim 1, Applicant respectfully requests reconsideration and allowance of claim 23.

Claim 24 is patentable for reasons similar to at least the reasons stated above with respect to claims 3 and 23.

The Office Action relies on the rationale in the rejection of claim 5 to support its rejection of claims 25 and 26. However, the rationale applied with respect to claim 5 appears inconsistent with the subject matter recited in claims 25 and 26. Applicant submits that claims 25 and 26 are patentable because the Office has failed to meet its initial burden in presenting a prima facie case of unpatentability. Notwithstanding the erroneous rejection, claim 25 is patentable for reasons similar to at least the reasons stated above with respect to claims 4 and 23. Claim 26 depends from claim 25 and is patentable for reasons similar to at least the reasons stated herein with respect to claims 18, 23 and 25.

Claim 27 is patentable for reasons similar to at least the reasons stated above with respect to claims 5 and 23.

Claim 29 is patentable for reasons similar to at least the reasons stated above with respect to claims 2, 14 and 23.

Claim 30 is patentable for reasons similar to at least the reasons stated above with respect to claims 15 and 23.

III. Rejection of Claims 6, 11, and 28 under 35 U.S.C. 103(a)

Claims 6, 11, and 28 are rejected under 35 U.S.C. 103(a) as being unpatentable over Cypher in view of Rowlands and further in view of U.S. Patent Publication No. 2005/0251631 to Rowlands et al. (“Rowlands ‘631”). Withdrawal of this rejection is respectfully requested for at least the following reasons.

Claim 6 depends from claim 5 and is patentable for at least the same reasons as discussed above with respect to claim since the addition of Rowlands ‘631 fails to cure the deficiencies noted above with respect to the combination of Cypher and Rowlands. The Office Action contends that Rowlands ‘631 discloses that a conflict can be recognized, as recited in claim 6, to avoid having agents conflicting with one another for resources. However, the discussion about avoiding conflicts (at paragraph [0010] of Rowlands ‘631 is described in the context of having multiple levels of priority as a means to prevent deadlock and conflict. That is, if conflicts are prevented by mechanisms being described, there would be no basis to recognize a conflict as is being suggested in the Office Action. Moreover, Rowlands ‘631 teaches that a remote line directory (RLD) can be organized as an n-way associative cache to reduce conflicts between different directory entries 1200 in the RLD

1116. Rowlands '631 at [0050]. Again, nothing here teaches or suggests recognizing conflicts, as it relates to an approach to reduce (not recognize) the occurrence of conflicts.

An eviction process is disclosed at paragraph [0062] of Rowlands '631 and mentions that a cache might not be able to accept an allocated remote line due to conflict in the cache. However, the only actions disclosed in Rowlands '631 is to either throw the request into the evict buffer if it is a write or , in the case of a remote line being read Modified, the L2 cache 1110 will place it into the evict buffer and WRITE_FLUSH to NC. Rowlands '631 at [0072]. This is contrast to retrying the source broadcast requests in response to recognizing the conflict, as recited in claim 5 from which claim 6 depends. Additionally, the particular recognition of conflict disclosed at paragraph [0072] and the error signaling disclosed at paragraph [0079] in Rowlands '631 fail to teach or suggest either of the conflict recognition scenarios recited in claim 6. Accordingly, the addition of Rowlands '631 to the combination of Cypher and Rowlands still fails to teach or suggest claim 6. For these reasons, Applicant respectfully requests reconsideration and allowance of claim 6.

Claims 11 and 28 are patentable for reasons similar to those discussed above with respect to claim 6.

IV. CONCLUSION

In view of the foregoing remarks, Applicant respectfully submits that the present application is in condition for allowance. Applicant respectfully requests reconsideration of this application and that the application be passed to issue.

Should the Examiner have any questions concerning this paper, the Examiner is invited and encouraged to contact Applicant's undersigned attorney at (216) 621-2234, Ext. 106.

No additional fees should be due for this response. In the event any fees are due in connection with the filing of this document, the Commissioner is authorized to charge those fees to Deposit Account No. 08-2025.

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